A DISLOCATION AND POINT FORCE APPROACH TO THE 2-D FRACTURE ANALYSIS OF THE GENERAL ANISOTROPIC SOLIDS

M. Denda
Mech. & Aero. Engineering Department
Rutgers University
98 Brett Rd., Piscataway, NJ 08854-8058
denda@jove.rutgers.edu

According to the physical interpretation of Somigliana's identity the displacement field in a finite body subject to the boundary traction t_i and displacement u_i is given by the continuous distributions of (1) the point forces with magnitude t_i and (2) the dislocation dipoles with Burgers vector u_i over a closed contour marked out in the infinite 2-D domain. Further a crack is represented by the continuous distribution of the dislocation dipoles with Burgers vector δ_i equal to the crack opening displacement.

We present a direct formulation of the boundary element method based on this physical interpretation of Somigliana's identity for problems containing multiple curvilinear cracks in the general anisotropic solids in 2-D. A special crack element, called the crack tip singular element (CTSE), that mathematically introduces the $\sqrt{r}$ COD and $1/\sqrt{r}$ stress behavior at the tip of each crack is developed [1, 2, 3]. The stress intensity factor results by the CTSE are compared with those obtained by the conservation integral technique [4] that does not use the CTSE. The proposed CTSE enables us to calculate the stress intensity factors of multiple cracks accurately and directly in the main processing without the need for time consuming post processing based on the conservation integrals.

References

[1] M. Denda and M.E. Marante, "Mixed mode BEM analysis of multiple curvilinear cracks in the general anisotropic solids by the crack tip singular element," Submitted for publication.
[2] M. Denda and Y.F. Dong, "Analytical formulas for a 2-D crack tip singular boundary element for rectilinear cracks and crack growth analysis," *Engng. Anal. with Boundary Elements*, v. 23(1), pp. 35-49, 1999
[3] M. Denda and E. Mattingly, "The whole crack singular element for 2-D boundary element analysis of multiple straight cracks in the general anisotropic solids," to appear in *Electronic J. of Boundary Elements.*
[4] M. Denda, "Mixed Mode I, II, and III analysis of multiple cracks in plane anisotropic solids by the BEM: a dislocation and point force approach," *Engng. Anal. with Boundary Elements*, v. 25(4-5), pp. 267-278, 2001.